

| WASTE STREAM | 3M317 | Decommissioning Stage 3: Graphite LLW |
|--------------|-------|---------------------------------------|
|--------------|-------|---------------------------------------|

**SITE** Heysham 2

**SITE OWNER** EDF Energy Nuclear Generation Ltd (EDFE NGL)

**WASTE CUSTODIAN** EDF Energy Nuclear Generation Ltd (EDFE NGL)

**WASTE TYPE** LLW

#### WASTE VOLUMES

|                        | Reported (m <sup>3</sup> )   | OR | Conditioned (m <sup>3</sup> ) | Packaged (m <sup>3</sup> ) |
|------------------------|------------------------------|----|-------------------------------|----------------------------|
| Stocks:                | At 1.4.2025 = 0              |    |                               |                            |
| Future arisings:       | 1.4.2025 - 31.3.2118 = 0     |    |                               |                            |
|                        | 1.4.2118 - 31.3.2119 = 207.3 |    |                               |                            |
|                        | 1.4.2119 - 31.3.2120 = 234.5 |    |                               |                            |
|                        | 1.4.2120 - 31.3.2121 = 212.3 |    |                               |                            |
| Total future arisings: | <b>654.0</b>                 |    |                               |                            |
| Total waste volume:    | <b>654.0</b>                 |    |                               |                            |

Number of waste packages in stock: At 1.4.2025..... - packages

Comment on arising rates: Waste volumes will be variable depending on station operating conditions.

Additional information on quantities: Volumes based on Back to Bio Shield strategy. Work is ongoing looking at optimising the strategy which could lead to a change in volume and timings of arisings across Final Site Clearance wastes (300s) and Pre C&M wastes (100s), in future submissions.

Uncertainty factors on volumes: Stock (upper): x - Arisings (upper): x 1.50  
Stock (lower): x - Arisings (lower): x 0.50

**WASTE SOURCE** Reflector and shield graphite from reactor dismantling.

#### PHYSICAL CHARACTERISTICS

General description: Graphite blocks and other graphite components. Waste can be packaged in standard NDA packages.

Changes since waste generated: -

Bulk density (t/m<sup>3</sup>): ~ 1.3

Comment on density: Assumes 10% of graphite will arise in rubble form with a worse packing efficiency than blocks.

#### CHEMICAL COMPOSITION

General description and components (%wt): Graphite and possible traces of ferrous metals.

Chemical state: -

Sheet metal proportion / thickness: Waste expected to be placed in metal 'baskets' before being placed in waste packages.

Metals and alloys (%wt):

|                           | (%wt) | Type(s) / Grades(s) with proportions | % of total C14 activity |
|---------------------------|-------|--------------------------------------|-------------------------|
| Stainless steel.....      | NE    | -                                    |                         |
| Other ferrous metals..... | NE    | -                                    |                         |
| Iron.....                 | = 0   | -                                    |                         |
| Aluminium.....            | = 0   | -                                    |                         |
| Beryllium.....            | = 0   | -                                    |                         |
| Cobalt.....               | = 0   | -                                    |                         |
| Copper.....               | = 0   | -                                    |                         |
| Lead.....                 | = 0   | -                                    |                         |
| Magnox/Magnesium.....     | = 0   | -                                    |                         |
| Nickel.....               | = 0   | -                                    |                         |
| Titanium.....             | = 0   | -                                    |                         |
| Uranium.....              | = 0   | -                                    |                         |
| Zinc.....                 | = 0   | -                                    |                         |
| Zircaloy/Zirconium.....   | = 0   | -                                    |                         |
| Other metals.....         | = 0   | -                                    |                         |

Organics (%wt):

|                                     | (%wt) | Type(s) and comment | % of total C14 activity |
|-------------------------------------|-------|---------------------|-------------------------|
| Total cellulose.....                | = 0   | -                   |                         |
| Paper, cotton.....                  | = 0   | -                   |                         |
| Wood.....                           | = 0   | -                   |                         |
| Halogenated plastics.....           | = 0   | -                   |                         |
| Total non-halogenated plastics..... | = 0   | -                   |                         |
| Condensation polymers.....          | = 0   | -                   |                         |
| Others.....                         | = 0   | -                   |                         |
| Organic ion exchange materials..... | = 0   | -                   |                         |
| Total rubber.....                   | = 0   | -                   |                         |
| Halogenated rubber.....             | = 0   | -                   |                         |
| Non-halogenated rubber.....         | = 0   | -                   |                         |
| Hydrocarbons.....                   | = 0   | -                   |                         |
| Oil or grease.....                  | -     | -                   |                         |
| Fuel.....                           | -     | -                   |                         |
| Asphalt/Tarmac (cont.coal tar)..... | -     | -                   |                         |
| Asphalt/Tarmac (no coal tar).....   | -     | -                   |                         |
| Bitumen.....                        | -     | -                   |                         |
| Others.....                         | -     | -                   |                         |
| Other organics.....                 | = 0   | -                   |                         |

Other materials (%wt):

|                                       | (%wt)   | Type(s) and comment | % of total C14 activity |
|---------------------------------------|---------|---------------------|-------------------------|
| Inorganic ion exchange materials..... | = 0     | -                   | 100.0                   |
| Inorganic sludges and flocs.....      | = 0     | -                   |                         |
| Soil.....                             | = 0     | -                   |                         |
| Brick/Stone/Rubble.....               | = 0     | -                   |                         |
| Cementitious material.....            | = 0     | -                   |                         |
| Sand.....                             | = 0     | -                   |                         |
| Glass/Ceramics.....                   | = 0     | -                   |                         |
| Graphite.....                         | = 100.0 | -                   |                         |
| Desiccants/Catalysts.....             | = 0     | -                   |                         |
| Asbestos.....                         | = 0     | -                   |                         |
| Non/low friable.....                  | -       | -                   |                         |
| Moderately friable.....               | -       | -                   |                         |
| Highly friable.....                   | -       | -                   |                         |
| Free aqueous liquids.....             | = 0     | -                   |                         |
| Free non-aqueous liquids.....         | = 0     | -                   |                         |
| Powder/Ash.....                       | = 0     | -                   |                         |

# COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

Inorganic anions (%wt):

|                | (%wt) | Type(s) and comment |
|----------------|-------|---------------------|
| Fluoride.....  | = 0   | -                   |
| Chloride.....  | = 0   | -                   |
| Iodide.....    | = 0   | -                   |
| Cyanide.....   | = 0   | -                   |
| Carbonate..... | = 0   | -                   |
| Nitrate.....   | = 0   | -                   |
| Nitrite.....   | = 0   | -                   |
| Phosphate..... | = 0   | -                   |
| Sulphate.....  | = 0   | -                   |
| Sulphide.....  | = 0   | -                   |

Materials of interest for waste acceptance criteria:

|                                                | (%wt) | Type(s) and comment |
|------------------------------------------------|-------|---------------------|
| Combustible metals.....                        | = 0   | -                   |
| Low flash point liquids.....                   | = 0   | -                   |
| Explosive materials.....                       | = 0   | -                   |
| Phosphorus.....                                | = 0   | -                   |
| Hydrides.....                                  | = 0   | -                   |
| Biological etc. materials.....                 | = 0   | -                   |
| Biodegradable materials.....                   | = 0   | -                   |
| Putrescible wastes.....                        | = 0   | -                   |
| Non-putrescible wastes.....                    | = 0   | -                   |
| Corrosive materials.....                       | = 0   | -                   |
| Pyrophoric materials.....                      | = 0   | -                   |
| Generating toxic gases.....                    | = 0   | -                   |
| Reacting with water.....                       | = 0   | -                   |
| Higher activity particles.....                 | P     | May be present.     |
| Soluble solids as bulk chemical compounds..... | = 0   | -                   |

Hazardous substances / non hazardous pollutants:

|                             | (%wt) | Type(s) and comment |
|-----------------------------|-------|---------------------|
| Acrylamide.....             | NE    | -                   |
| Benzene.....                | NE    | -                   |
| Chlorinated solvents.....   | NE    | -                   |
| Formaldehyde.....           | NE    | -                   |
| Organometallics.....        | NE    | -                   |
| Phenol.....                 | NE    | -                   |
| Styrene.....                | NE    | -                   |
| Tri-butyl phosphate.....    | NE    | -                   |
| Other organophosphates..... | NE    | -                   |
| Vinyl chloride.....         | NE    | -                   |
| Arsenic.....                | NE    | -                   |
| Barium.....                 | NE    | -                   |
| Boron.....                  | NE    | -                   |
| Boron (in Boral).....       | NE    | -                   |
| Boron (non-Boral).....      | NE    | -                   |
| Cadmium.....                | NE    | -                   |
| Caesium.....                | NE    | -                   |
| Selenium.....               | NE    | -                   |
| Chromium.....               | NE    | -                   |
| Molybdenum.....             | NE    | -                   |
| Thallium.....               | NE    | -                   |
| Tin.....                    | NE    | -                   |
| Vanadium.....               | NE    | -                   |
| Mercury compounds.....      | NE    | -                   |
| Others.....                 | NE    | -                   |

Complexing agents (%wt):

| Not yet determined             |       |                                |
|--------------------------------|-------|--------------------------------|
|                                | (%wt) | Type(s) and comment            |
| EDTA.....                      | NE    | -                              |
| DPTA.....                      | NE    | -                              |
| NTA.....                       | NE    | -                              |
| Polycarboxylic acids.....      | NE    | -                              |
| Other organic complexants..... | NE    | Only trace quantities, if any. |
| Total complexing agents.....   | NE    | -                              |

Physical components:

|                                         | Number | Type(s) and comment |
|-----------------------------------------|--------|---------------------|
| Sources.....                            | = 0    | -                   |
| Electronic & Electrical Equipment (EEE) |        |                     |
| EEE Type 1.....                         |        | -                   |
| EEE Type 2.....                         |        | -                   |
| EEE Type 3.....                         |        | -                   |
| EEE Type 4.....                         |        | -                   |
| EEE Type 5.....                         |        | -                   |

## TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

| Treatment                                                  | On-site / Off-site | Stream volume % |
|------------------------------------------------------------|--------------------|-----------------|
| Size reduction                                             |                    |                 |
| Decay storage                                              |                    |                 |
| Low force compaction                                       |                    |                 |
| Supercompaction (HFC)                                      |                    |                 |
| Incineration                                               |                    |                 |
| Drying/dewatering/liquid separation                        |                    |                 |
| Tie down/fixatives/strippable coating/painting application |                    |                 |
| Decontamination                                            |                    |                 |
| Metal treatment                                            |                    |                 |
| Recycling / reuse                                          |                    |                 |
| Thermal treatment, including vitrification                 |                    |                 |
| Encapsulation                                              |                    |                 |
| Polymer encapsulation                                      |                    |                 |
| Other physical treatment                                   |                    |                 |
| Other chemical treatment                                   |                    |                 |
| Containerisation                                           |                    |                 |
| Treatment not yet determined                               |                    |                 |
| None                                                       |                    | = 100.0         |

Comments on planned treatments:

The waste will be placed in metal baskets in the waste packages, The waste is not expected to be compacted nor subject to any other treatment, however, if necessary could be encapsulated.

Conditioning method:

-

Conditioning plants:

| Plant Name | Location |
|------------|----------|
|            |          |

Likely conditioning matrix:

-

Further information on the conditioning matrix:

-

**Waste Packaging:**

| Likely container type: | Container     | Waste packaged (vol%) | Waste loading (m³) | Payload (m³) | Number of packages | Estimated start date for packaging |
|------------------------|---------------|-----------------------|--------------------|--------------|--------------------|------------------------------------|
|                        | 4 m box (LLW) | 100.0                 | 15.0               | 16.2         | 44                 | -                                  |

Range in container waste loading:

Other information on packaging and conditioning: The waste will probably be in baskets placed in the waste packages. Conditioned density 1.86 t/m³

Conditioned density (t/m³): ~ 1.9  
Conditioned density comment: -

**Management Routes:**

| Disposal Route                                                                     | Stream volume % | Raw density t/m³ | Start date |
|------------------------------------------------------------------------------------|-----------------|------------------|------------|
| Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland) | = 100.0         | ~ 1.3            |            |
| Expected to be Non-NSD HAW managed under Scottish Government's policy              |                 |                  |            |
| Expected to be disposed to LLW Vaults NRS Dounreay                                 |                 |                  |            |
| Expected to be consigned to the Geological Disposal Facility                       |                 |                  |            |
| Expected to be consigned to a Near Surface Disposal Facility                       |                 |                  |            |
| Expected to be consigned to the LLW Repository                                     |                 |                  |            |
| Expected to be consigned to a Landfill Facility                                    |                 |                  |            |
| Expected to be disposed On-Site                                                    |                 |                  |            |
| Expected to be managed by In-Situ Disposal                                         |                 |                  |            |
| Expected to be consigned to an Incineration Facility                               |                 |                  |            |
| Expected to be consigned to a Metal Treatment Facility                             |                 |                  |            |
| Expected to be Out of Scope                                                        |                 |                  |            |
| Expected to be recycled / reused                                                   |                 |                  |            |
| Disposal route not known                                                           |                 |                  |            |

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: No

| Baseline Management Route | Opportunity Management Route | Stream volume (%) | Opportunity Confidence | Comment |
|---------------------------|------------------------------|-------------------|------------------------|---------|
| -                         | -                            | -                 | -                      | -       |

**RADIOACTIVITY**

Source: Activation of the graphite and impurities, Contamination by other activated materials.

Uncertainty: The values quoted were derived by calculation from available material specification and are indicative of the activities that are expected. A major source of uncertainty is the impurity levels.

Measurement of radioactivities: Activation/decay calculations based on neutron flux and operating history. There may be some contamination by Cs137. The activities quoted are from the time at which this waste will arise (i.e. ~85 years after end of generation).

Chemical form of radionuclides: H-3: Diffused into matrix.  
C-14: Incorporated in the graphite.  
Cl-36: Incorporated in the graphite.  
Se-79: Not significant.  
Tc-99: Not determined.  
I-129: Not significant.  
Ra: Radium content is insignificant.  
Th: Thorium content is insignificant.  
U: Uranium content is insignificant.  
Np: Neptunium content is insignificant.  
Pu: Plutonium content is insignificant.

| WASTE STREAM 3M317 Decommissioning Stage 3: Graphite LLW |                            |                |                 |                |                  |                            |                |                 |                |
|----------------------------------------------------------|----------------------------|----------------|-----------------|----------------|------------------|----------------------------|----------------|-----------------|----------------|
| Nuclide                                                  | Mean radioactivity, TBq/m³ |                |                 |                | Nuclide          | Mean radioactivity, TBq/m³ |                |                 |                |
|                                                          | Waste at 1.4.2025          | Bands and Code | Future Arisings | Bands and Code |                  | Waste at 1.4.2025          | Bands and Code | Future Arisings | Bands and Code |
| H 3                                                      |                            |                | 3.91E-04        | C C 2          | Gd 153           |                            |                |                 |                |
| Be 10                                                    |                            |                |                 | 8              | Ho 163           |                            |                |                 |                |
| C 14                                                     |                            |                | 2.80E-04        | C C 2          | Ho 166m          |                            |                | 1.00E-06        | C C 2          |
| Na 22                                                    |                            |                |                 | 4              | Tm 170           |                            |                |                 |                |
| Al 26                                                    |                            |                |                 | 4              | Tm 171           |                            |                |                 |                |
| Cl 36                                                    |                            |                | 4.72E-06        | C C 2          | Lu 174           |                            |                |                 |                |
| Ar 39                                                    |                            |                |                 |                | Lu 176           |                            |                |                 |                |
| Ar 42                                                    |                            |                |                 |                | Hf 178n          |                            |                |                 |                |
| K 40                                                     |                            |                |                 |                | Hf 182           |                            |                |                 |                |
| Ca 41                                                    |                            |                | 1.41E-06        | C C 2          | Pt 193           |                            |                |                 |                |
| Mn 53                                                    |                            |                |                 |                | Ti 204           |                            |                |                 |                |
| Mn 54                                                    |                            |                |                 | 8              | Pb 205           |                            |                |                 |                |
| Fe 55                                                    |                            |                |                 | 8              | Pb 210           |                            |                |                 | 8              |
| Co 60                                                    |                            |                | 3.29E-07        | C C 2          | Bi 208           |                            |                |                 |                |
| Ni 59                                                    |                            |                | 6.10E-06        | C C 2          | Bi 210m          |                            |                |                 |                |
| Ni 63                                                    |                            |                | 3.53E-04        | C C 2          | Po 210           |                            |                |                 | 8              |
| Zn 65                                                    |                            |                |                 | 8              | Ra 223           |                            |                |                 |                |
| Se 79                                                    |                            |                |                 | 8              | Ra 225           |                            |                |                 |                |
| Kr 81                                                    |                            |                |                 |                | Ra 226           |                            |                |                 | 8              |
| Kr 85                                                    |                            |                |                 |                | Ra 228           |                            |                |                 |                |
| Rb 87                                                    |                            |                |                 |                | Ac 227           |                            |                |                 |                |
| Sr 90                                                    |                            |                |                 | 8              | Th 227           |                            |                |                 |                |
| Zr 93                                                    |                            |                |                 | 8              | Th 228           |                            |                |                 |                |
| Nb 91                                                    |                            |                |                 |                | Th 229           |                            |                |                 | 8              |
| Nb 92                                                    |                            |                |                 |                | Th 230           |                            |                |                 | 8              |
| Nb 93m                                                   |                            |                |                 | 8              | Th 232           |                            |                |                 | 8              |
| Nb 94                                                    |                            |                |                 | 8              | Th 234           |                            |                |                 |                |
| Mo 93                                                    |                            |                | 3.57E-08        | C C 2          | Pa 231           |                            |                |                 | 8              |
| Tc 97                                                    |                            |                |                 |                | Pa 233           |                            |                |                 |                |
| Tc 99                                                    |                            |                | 7.16E-09        | C C 2          | U 232            |                            |                |                 |                |
| Ru 106                                                   |                            |                |                 | 8              | U 233            |                            |                |                 | 8              |
| Pd 107                                                   |                            |                |                 | 8              | U 234            |                            |                |                 | 8              |
| Ag 108m                                                  |                            |                | 3.56E-07        | C C 2          | U 235            |                            |                |                 | 8              |
| Ag 110m                                                  |                            |                |                 |                | U 236            |                            |                |                 | 8              |
| Cd 109                                                   |                            |                |                 |                | U 238            |                            |                |                 | 8              |
| Cd 113m                                                  |                            |                |                 |                | Np 237           |                            |                |                 | 8              |
| Sn 119m                                                  |                            |                |                 |                | Pu 236           |                            |                |                 |                |
| Sn 121m                                                  |                            |                | 2.20E-09        | C C 2          | Pu 238           |                            |                |                 | 8              |
| Sn 123                                                   |                            |                |                 |                | Pu 239           |                            |                |                 | 8              |
| Sn 126                                                   |                            |                |                 | 8              | Pu 240           |                            |                |                 | 8              |
| Sb 125                                                   |                            |                |                 |                | Pu 241           |                            |                |                 | 8              |
| Sb 126                                                   |                            |                |                 |                | Pu 242           |                            |                |                 | 8              |
| Te 125m                                                  |                            |                |                 |                | Am 241           |                            |                |                 | 8              |
| Te 127m                                                  |                            |                |                 |                | Am 242m          |                            |                |                 | 8              |
| I 129                                                    |                            |                |                 | 8              | Am 243           |                            |                |                 | 8              |
| Cs 134                                                   |                            |                |                 | 8              | Cm 242           |                            |                |                 | 8              |
| Cs 135                                                   |                            |                |                 | 8              | Cm 243           |                            |                |                 | 8              |
| Cs 137                                                   |                            |                |                 | 8              | Cm 244           |                            |                |                 | 8              |
| Ba 133                                                   |                            |                | 9.39E-09        | C C 2          | Cm 245           |                            |                |                 | 8              |
| La 137                                                   |                            |                |                 |                | Cm 246           |                            |                |                 | 8              |
| La 138                                                   |                            |                |                 |                | Cm 248           |                            |                |                 |                |
| Ce 144                                                   |                            |                |                 | 8              | Cf 249           |                            |                |                 |                |
| Pm 145                                                   |                            |                | 4.80E-09        | C C 2          | Cf 250           |                            |                |                 |                |
| Pm 147                                                   |                            |                |                 | 8              | Cf 251           |                            |                |                 |                |
| Sm 147                                                   |                            |                |                 |                | Cf 252           |                            |                |                 |                |
| Sm 151                                                   |                            |                | 1.37E-06        | C C 2          | Unsp a           |                            |                |                 | 8              |
| Eu 152                                                   |                            |                | 9.78E-06        | C C 2          | Unsp b/g         |                            |                |                 | 8              |
| Eu 154                                                   |                            |                | 1.04E-07        | C C 2          | <b>Total a</b>   | <b>0</b>                   | <b>*</b>       | <b>1.34E-17</b> | <b>*</b>       |
| Eu 155                                                   |                            |                |                 | 8              | <b>Total b/g</b> | <b>0</b>                   | <b>*</b>       | <b>1.05E-03</b> | <b>*</b>       |

#### Bands (Upper and Lower)

A a factor of 1.5  
B a factor of 3  
C a factor of 10  
D a factor of 100  
E a factor of 1000

Note: Bands quantify uncertainty in the mean radioactivity.

#### Code

1 Measured activity  
2 Derived activity (best estimate)  
3 Derived activity (upper limit)  
4 Not present  
5 Present but not significant  
6 Likely to be present but not assessed  
7 Present in significant quantities but not determined  
8 Not expected to be present in significant quantity  
\* Total calculated from the 114 declared radionuclides